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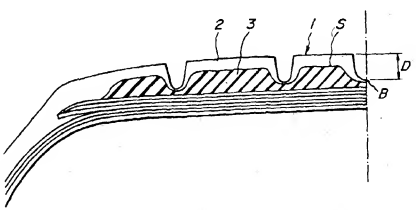
(54) Pneumatic radial tires

(57) A pneumatic radial tire comprises a tread portion (1) having a two-layer structure of a cap rubber layer (2) disposed outward in the radial direction and a base rubber layer (3) disposed inward in the radial direction, in which an outer surface (S) of said base rubber layer (3) in the radial direction is existent in a position corresponding to not less than 20% of a depth (D) of a main groove formed in the tread portion outward from a bottom (B) of the main groove in the radial direction, and the base rubber layer (3) being compounded with a re-crosslinking inhibition assistant and/or an inorganic compound powder

FIG_1



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EUROPEAN SEARCH REPORT

Application Number
EP 98 30 2637

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 5 225 011 A (ODA KEIJIRO ET AL) 6 July 1993 * abstract; claims; figure 2; examples; tables 1,2 * ---	1-6, 8-14,17	B60C11/00 B60C1/00 B60C11/18
X	EP 0 732 229 A (GOODYEAR TIRE & RUBBER) 18 September 1996 * abstract; claims; figure 8; example II; tables 1,2 * ---	1-3, 5-14,17	
X	EP 0 738 614 A (GOODYEAR TIRE & RUBBER) 23 October 1996 * abstract; example 1; table 1 * * page 11, line 50 - line 59 * ---	1-3,6,17	
A	GRAF H -J ET AL: "REVERSIONSBESTANDIGKEIT VON NATURKAUTSCHUKMISCHUNGEN BEI VERWENDUNGVON DI-THIOPHOSPHAT-VULKANISATIONSSYSTEMEN" GUMMI, FASERN, KUNSTSTOFFE INTERNATIONALE FACHZEITSCHRIFT FUR DIE POLYMER-VERARBEITUNG, vol. 49, no. 12, December 1996, pages 984-995, XP000637324 * page 995, Zusammenfassung * ---		TECHNICAL FIELDS SEARCHED (Int.Cl.6) C08K B60C
P,X	EP 0 818 501 A (BRIDGESTONE CORP) 14 January 1998 * abstract; claims 1,18-26; examples 6-10; tables 5,6 * ---	1-17	
P,X	EP 0 832 920 A (BRIDGESTONE CORP) 1 April 1998 * abstract; examples; tables 1,2 * * page 3, line 35 - line 40 * * page 5, line 2 - line 3 * -----	1-3,5,7, 17	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 December 1998	Mettler, R-M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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Comparative Example 4 is a tire having the conventional type tread structure and is large in the difference of wet performance between new tire and worn tire. In Example 9, the slight improvement of the wet performance is observed at the last worn stage and the difference of wet performance is small as compared with that of Comparative Example 4. In Examples 10 and 11, the deterioration of wet performance at the middle worn stage is controlled, while the wet performance at the last worn stage is deteriorated, but the difference of wet performance between new tire and worn tire is small as compared with that of Comparative Example 4. In Examples 12, 13 and 14, the wet performance is maintained over a period from the middle worn stage to the last worn stage and the difference of wet performance from new tire stage is very small.

As mentioned above, in the pneumatic radial tire according to the invention, the tread portion is rendered into a particular cap/base structure and a recrosslinking inhibition assistant and/or inorganic compound powder is compounded into a base rubber, whereby the wet-μ at the last worn stage can effectively be enhanced without obstructing the productivity to control the degradation of the wet performances. Furthermore, the silence and ride comfort against vibrations on or after the middle worn stage are simultaneously improved.

Claims

1. A pneumatic radial tire comprising a pair of ring-shaped bead cores, bead fillers disposed on the bead cores, a carcass toroidally extending between the bead cores and comprised of a rubberized ply containing plural cords arranged side by side in a radial direction and wound around each bead core from the inside toward the outside thereof to form a turnup portion, a belt comprising a plurality of belt layers arranged outward on the carcass in the radial direction, an annular tread portion (1) disposed outward on the belt in the radial direction, and a pair of sidewall portions extending from both ends of the tread portion; said tread portion having a two-layer structure of a cap rubber layer (2) disposed outward in the radial direction and a base rubber layer (3) disposed inward in the radial direction, and an outer surface (S) of said base rubber layer (3) in the radial direction being existent in a position corresponding to not less than 20% of a depth (D) of a main groove formed in said tread portion outward from a bottom (B) of said main groove in the radial direction, and said base rubber layer (3) being compounded with a recrosslinking inhibition assistant and/or an inorganic compound powder.

2. A tire as claimed in claim 1, characterized in that the base rubber layer (3) is compounded with 0.5-5.0 parts by weight of recrosslinking inhibition assistant based on 100 parts by weight of rubber ingredient.

3. A tire as claimed in claim 1 or 2, characterized in that the base rubber layer (3) is compounded with not less than 10 parts by weight of inorganic compound powder based on 100 parts by weight of rubber ingredient.

4. A tire as claimed in any of claims 1 to 3, characterized in that the inorganic compound powder is compounded into the base rubber layer (3) in an amount of 10-100 parts by weight based on 100 parts by weight of rubber ingredient and into the cap rubber layer (2) in an amount of not more than 50 parts by weight based on 100 parts by weight of rubber ingredient, respectively, provided that the compounding ratio of the inorganic compound powder in the base rubber layer is higher than that in the cap rubber layer.

5. A tire as claimed in any of claims 1 to 4, characterized in that the recrosslinking inhibition assistant is compounded into the cap rubber layer (2).

6. A tire as claimed in any of claims 1 to 5, characterized in that the inorganic compound powder is silica or aluminium hydroxide.

7. A tire as claimed in any of claims 1 to 6, characterized in that the recrosslinking inhibition assistant is a metal salt of dithiophosphoric acid, a thiuram type vulcanization accelerator or a 4-methylbenzothiazole type compound.

8. A tire as claimed in any of claims 1 to 7 characterized in that the outer surface (S) of the base rubber layer (3) in the radial direction is existent in a position from the bottom (B) of the main groove within a range of 30-90% of the main groove depth (D).

9. A tire as claimed in claim 8, characterized in that the outer surface of the base rubber layer (3) in the radial direction is existent in a position from the bottom (B) of the main groove within a range of 40-60% of the main groove depth (D).

10. A tire as claimed in any of claims 1 to 9, characterized in that a volume ratio of cap rubber layer (2) to base rubber layer (3) is 1:0.5-1.0.

11. A tire as claimed in any of claims 1 to 10, characterized in that the base rubber layer (3) is arranged on a central zone of the tread portion (1) at a width corresponding to 40-60% of a ground contact width of the tread portion.

12. A tire as claimed in any of claims 1 to 11, characterized in that a volume ratio of cap rubber layer (2) to base rubber layer (3) in each of blocks forming the tread pattern at a distance from the bottom (B) of the groove to the outer surface of the tread portion (1) in the radial direction is 9:1-2:8.

13. A tire as claimed in any of claims 1 to 12, characterized in that the base rubber layer (3) having a convex structure is a main part of a ground contact region at a middle worn stage and then contacts with the ground as a main part until at least an appearance of slip sign.

14. A tire as claimed in any of claims 1 to 13, characterized in that a ratio of the base rubber layer (3) contacting with the ground gradually increases as compared with a ratio of the cap rubber layer (2) contacting with the ground with the advance of wearing from the middle worn stage.

15. A tire as claimed in any of claims 1 to 14, characterized in that the friction coefficient of the base rubber layer (3) on a wet road surface is at least 105% of that of the cap rubber layer (2).

16. A tire as claimed in any of claims 1 to 15, characterized in that the cap rubber layer (2) has a thermal curing ratio of 100-160% after a modulus of elasticity at 300% elongation (M300) is held at 100°C for 48 hours and the base rubber layer (3) has a thermal curing ratio of 100-150%, provided that the thermal curing ratio of the base rubber layer is lower than that of the cap rubber layer.

17. A tire as claimed in any of claims 1 to 16, characterized in that the base rubber layer (3) contains not more than 55 parts by weight of an oil based on 100 parts by weight of rubber ingredient.

18. A tire as claimed in any of claims 1 to 17, characterized in that the base rubber layer (3) contains short fibers.

FIG_1